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Comparison of Lung Aeration in Patients with Pulmonary Edema on Cpap Versus Bipap Therapy as Assesed by Lung Sonogram

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Abstract

Background: Pulmonary edema in patients with heart failure is a life threatening emergency, mostly treated with medical management and oxygen. Using of NIV in patients with pulmonary edema along with medical managements helps in better clinical outcome in terms of less duration of hospital stay and prevention of getting into invasive ventilatory support. Even though most of the meta analysis showed no difference between BIPAP and CPAP in reducing mortality ,in this study we intend to see improvement in lung aeration score with BIPAP over CPAP by ultrasonography.50 consecutive Patients aged above 40 yrs with respiratory rate more than 35 , room air saturation less than 92% and NTPROBNP more than 10000 were allocated 25 for BIPAP and 25 for CPAP group depending on clinical equipoise and intensive care department decision .Lung aeration score done by USG in 12 quadrants and scores measured as T0,T1,T2 before initiation of NIV , 2 hrs after initiation and 8 hrs after initiation of NIV respectively. Secondary outcome with NIV failure and need for mechanical ventilation was also assessed. **Results:** out of 50 patients, 26 female and 24 male enrolled. Serial lung USG score from T0 to T2 showed significant decreasing trend. BIPAP showed more decreasing trend than CPAP. Among all 3components of LUS scores, posterior component constituted the largest fraction at all time points. Duration of NIV showed strong negative correlation with change in LUS score after 8 hrs of initiation (T0 – T2) **Conclusions:** Lung aeration score improvement was better with BIPAP than CPAP especially in T1 score. Of the 50 patients one patient in BIPAP group and three patients in CPAP group got mechanically ventilated. There is no difference in length of hospital stay and mortality. Uniformly poorer aeration was observed in posterior regions of lung. Keywords: Heart failure, acute pulmonary edema, BIPAP, CPAP, lung aeration, lung ultrasound

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Introduction

Aim:

To study the clinical effectiveness of BIPAP vs. CPAP in adults admitted with acute pulmonary edema using lung ultrasound-based lung aeration index score.

Materials and methods:

Study design: Non-randomized two parallel arm comparison study

Setting: Multidisciplinary Adult Intensive Care unit at a tertiary care Centre

Study Methods:

All consecutive adult patients aged 40 years to 90years presenting to Multidisciplinary Adult ICU with pulmonary edema as per our study definition during the study period (05/2019 to 02/2020) have been screened for study eligibility. Those found eligible have been approached

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for informed consent. After obtaining informed consent, the enrolled patients were classified to receive either CPAP or BIPAP support. The option of BiPAP vs CPAP was based on clinical equipoise among the treating team members and not by random allocation. . Patients who were hemodynamically unstable with massive pleural effusion, severe pneumonia were excluded. NIV failure was considered when symptoms persist beyond 8 hrs of initiation of NIV and when patient becomes hemodynamically unstable with HR > 100, or < 60, RR > 35, SBP < 100 or >170,spo2 < 92 with FIO2 > 80.Patients with NIV failure were put on mechanical ventilation.(2)

A bedside lung ultrasonography using Esoate ultrasound machine model my lab 7 and a standard 3-4 Hz probe were performed before commencing NIV and aeration observed was quantified as LUS score (T0), T1 (within 2 hrs of initiation of NIV), T2 (within 8 hrs of initiation of NIV)

LUS was performed bedside by one of the two observers (primary investigator or the junior consultant) who underwent 15 days of training in LUS, PERFORMED 25 LUS each and were standardized with an expert sonologist. In addition to primary outcome, the secondary outcome, to find out NIV failure and the need to put on mechanical ventilation were also obtained.

Inclusion And Exclusion Criteria:

Inclusion Criteria:

All consecutive adults admitted to intensive care unit who are clinically diagnosed as pulmonary edema

Hemodynamically stable

NTPROBNP >10000

SPO2 < 92% in room air

Respiratory rate > 35

Exclusion Criteria

Hemodynamically unstable

SPO2 > 92 % room air

Massive pleural effusion

Combined with severe pneumonia

Definitions

Acute pulmonary edema

Sudden onset of shortness of breath in patients with background heart disease with respiratory rate more than 35,Spo2 less than 92% in room air and Ntprobnp more than 10000

Lung Ultrasound Score

Lus Score

6 regions in each hemithorax: 3 areas delimited by sternum, anterior and posterior axillary lines, each subdivided into superior and inferior regions, and termed anterosuperior, anteroinferior, laterosuperior, lateroinferior, posterosuperior and posteroinferior. For each given area of interests, points allocated according to worst USG pattern observed (Figure 1)normal= 0, well separated B lines =1,coalescent b lines = 2, and consolidation, shred signs =3 and summated as LUS scores ranging from 0 to 36.Low lung USG score indicated better aeration, higher score indicated poor aeration(1)

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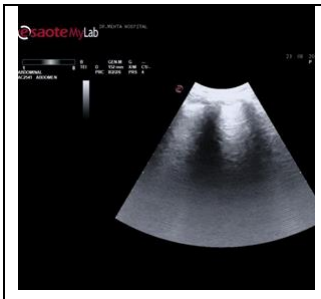
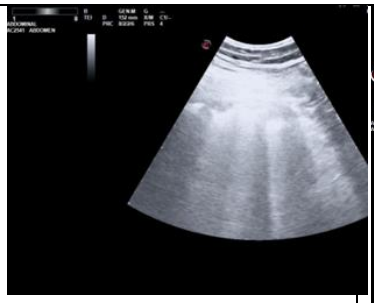
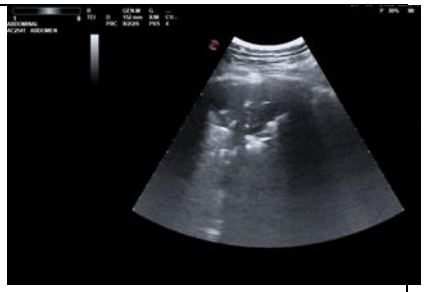
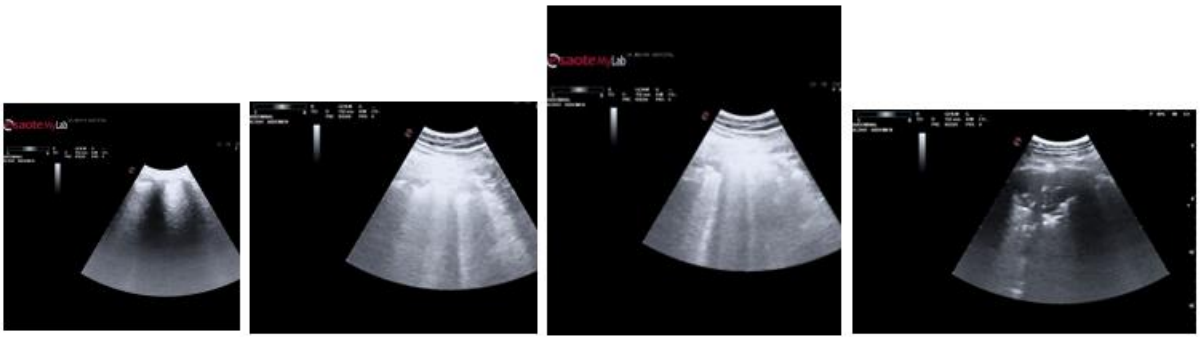
			
SCORE - 0 Normal aeration	**SCORE - 1 Moderate loss of aeration. Multiple B Lines**	**SCORE - 2 Severe loss of aeration. Multiple coalescent B lines**	**SCORE - 3 Lung consolidation. Complete loss of aeration.**

STUDY METHADOLOGY



SCORE - 0 Normal aeration
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SCORE - 3 Lung consolidation. Complete loss of aeration.

Discussion

Both BIPAP and CPAP alters airway pressure when a patient does spontaneous breathing. During Pulmonary edema this increase in pressure helps to deliver oxygen to lungs. CPAP delivers constant pressure throughout respiration. This makes expiration more difficult when higher pressures are required where patient has to expire against high pressures. BIPAP delivers varying pressures for inspiration and expiration with IPAP for inspiration and EPAP for expiration.(3) Also BIPAP machine has backup respiratory rate so that if patient becomes apneic suddenly, it helps in initiating breaths. Because of these reasons BIPAP has better

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effect in reducing the work of breathing and many people find BIPAP more comfortable than CPAP.(3,4,5)

Even though there are meta analysis and studies which states that there is no difference in outcome when patients in pulmonary edema are treated with BIPAP or CPAP, those studies have not taken real time lung aeration into consideration (6) Here in this study we used real time lung aeration changes when treated with BIPAP and CPAP. The inclusion criteria had parameters like ntprobnp, oxygen saturation, age and respiratory rate so that both the groups are comparable.

Everything said still BPAP vs CPAP selection is difficult because individual patients behave differently to both BIPAP and CPAP .So ideally it has to be based on patient comfort, Oxygenation improvement , clinical and biomedical parameters after starting the device.(7)

In our study we found that lung aeration was better with BIPAP when compared with CPAP. We also observed that patients treated with BIPAP are more comfortable.(8)Since it required 12 areas to be scanned and USG skills of different individuals differ, better training in usg is required for future growth and research using usg.

Results

Out of 50 patients enrolled with mean age group -Serial LUS score from initiation of NIV to 8 hrs showed decreasing trend in LUS score more with BIPAP than CPAP. Duration of NIV beyond 8 hrs showed negative correlation with LUS score. LUS score was more in the posterior segments than other segments during study.(9,10)

STATISTICAL ANALYSIS:

Conclusions

Lung aeration score improvement was better with BIPAP than CPAP especially in T1 score. Of the 50 patients one patient in BIPAP group and three patients in CPAP group got mechanically ventilated. There is no difference in length of hospital stay and mortality. Uniformly poorer aeration was observed in posterior regions of lung.

Table

PATIENT	AGE	SEX	NTPROBNP	NIV	T0	T1	T2
1	71	F	20000	BIPAP	24	18	8
2	80	F	18000	CPAP	24	24	20
3	89	F	14000	CPAP	16	20	24
4	66	F	24000	BIPAP	18	16	8
5	71	M	12000	CPAP	12	12	8
6	57	M	22000	CPAP	24	20	24
7	76	M	24400	CPAP	16	20	24
8	71	M	28000	CPAP	12	8	4
9	80	F	30000	CPAP	24	24	24
10	40	F	32000	CPAP	24	24	24
11	54	M	32000	CPAP	22	22	24
12	72	M	35000	CPAP	22	24	24
13	79	F	35000	CPAP	24	24	24
14	52	F	28000	CPAP	20	22	24
15	46	F	25000	CPAP	16	18	24
16	48	M	26000	CPAP	18	24	24
17	64	F	12000	CPAP	12	12	8
18	65	F	30000	CPAP	16	20	24

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19	86	F	35000	CPAP	22	24	24
20	79	F	22000	CPAP	26	24	26
21	53	M	16000	CPAP	16	16	16
22	56	M	24000	CPAP	12	16	24
23	84	M	28000	CPAP	22	24	26
24	89	M	30000	CPAP	26	24	24
25	90	F	29000	CPAP	20	22	24
26	64	F	28000	CPAP	22	24	24
27	60	M	30000	CPAP	24	24	24
28	80	F	32000	CPAP	24	24	26
29	43	F	24000	BIPAP	22	20	12
30	59	M	26000	BIPAP	24	20	16
31	57	F	35000	BIPAP	26	26	30
32	77	F	22000	BIPAP	26	12	12
33	60	M	14000	BIPAP	20	16	8
34	45	M	16000	BIPAP	22	20	8
35	61	M	18000	BIPAP	20	16	8
36	60	F	12000	BIPAP	12	8	4
37	76	M	14000	BIPAP	16	16	12
38	86	F	16000	BIPAP	22	16	12
39	71	F	29000	BIPAP	20	18	12
40	63	M	18000	BIPAP	16	12	8
41	65	F	16000	BIPAP	20	16	8
42	70	M	32000	BIPAP	24	24	20
43	57	F	30000	BIPAP	18	16	8
44	78	M	32000	BIPAP	16	18	12
45	52	F	30000	BIPAP	14	16	12
46	48	M	32000	BIPAP	14	12	8
47	80	M	35000	BIPAP	26	24	16
48	80	F	30000	BIPAP	20	22	12
49	59	M	26000	BIPAP	16	12	8
50	63	M	24000	BIPAP	12	16	8

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